SAS status and and Near Future Developments

Richard Saxton & Aitor Ibarra

25th XMM-Newton UG meeting

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Outline

- SAS v22 release

- Feedback from last UG

- A new build system

- Use of SAS within cloud processing environments

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SAS 22 release dates and o/s

Release planned for October 2024

Based on GCC 13 and released in two 64-bit binary versions for Linux

(Red Hat Enterprise Linux 8.6 and Ubuntu 24.04LTS and 22.04LTS), and one for MacOS 15 (Sequoia).

These versions will be tested on

several other platforms including MacOS Bigsur (11.6) and Ventura-M1 (13.2).

Ubuntu 22 version also available in a VM and Docker

XMM Docker available in ESA Datalabs collaborative learning (https://datalabs.esa.int)

SAS v22 major changes
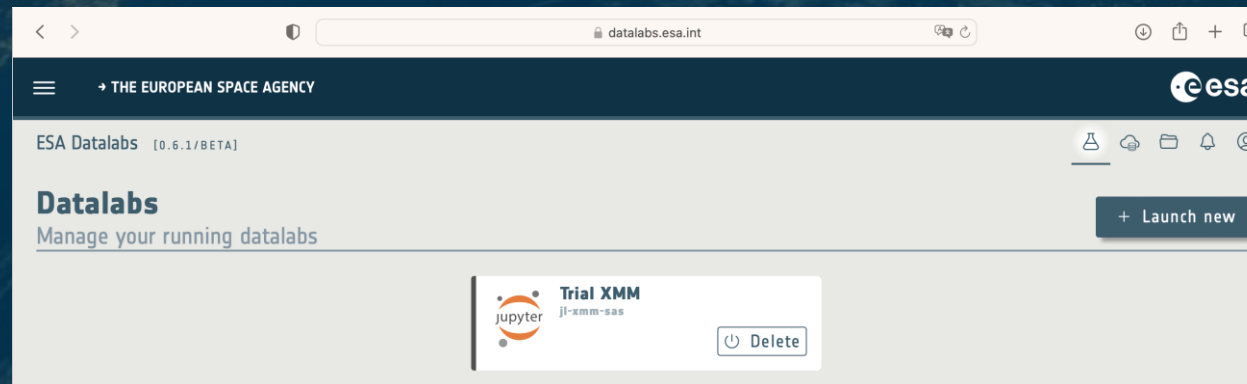
- **Further Python development channeled towards Jupyter notebooks and the DataLabs on-line processing infrastructure**
- OM updates, mainly related to catalogue production
- **OM sensitivity degradation, new algorithm.**
- OM position-dependent sensitivity correction (Jupiter patch)
- **Fix of astrometry error affecting large mosaic images**
- ESAS minor updates
- **MOS->pn and RGS->pn effective area corrections applied by default**
- Automatic setting of the EPIC canned RMF name within especget (using new EPN_RMFEPOCH_0001.CCF)
- **edetect_chain changes – improved sensitivity assuming constant flux between cameras (and obs.)**
- Some NR code removal (not yet complete)
- **Improved treatment of EPIC-pn Time Jumps (if time permits)**
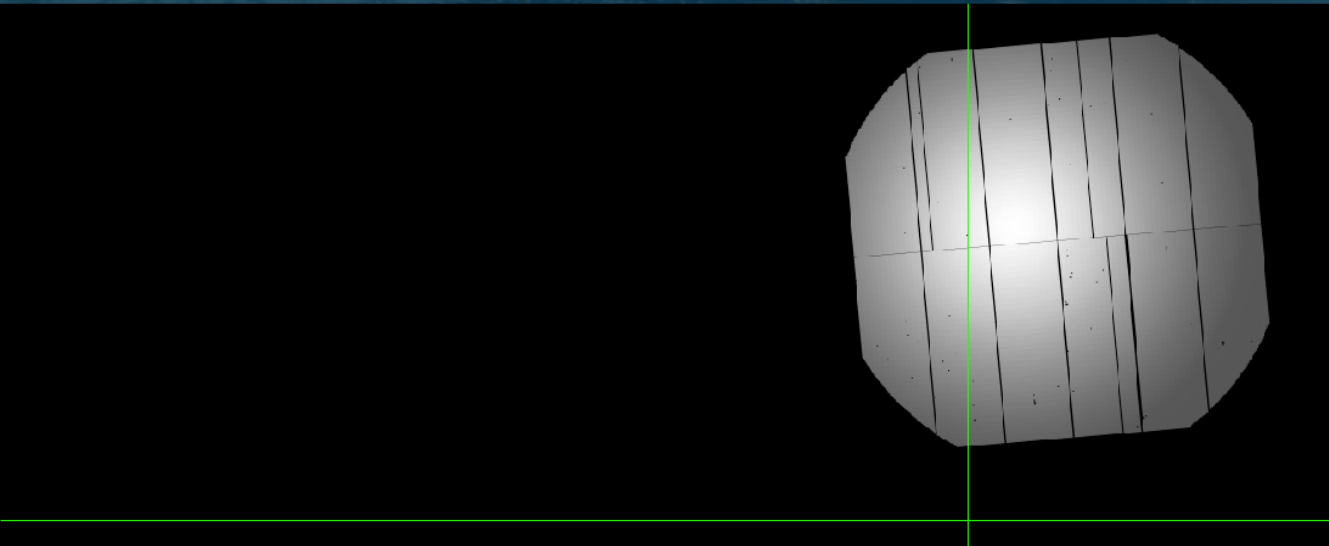- New configuration, build and test system

SAS v22 astrometry fix for large mosaic images

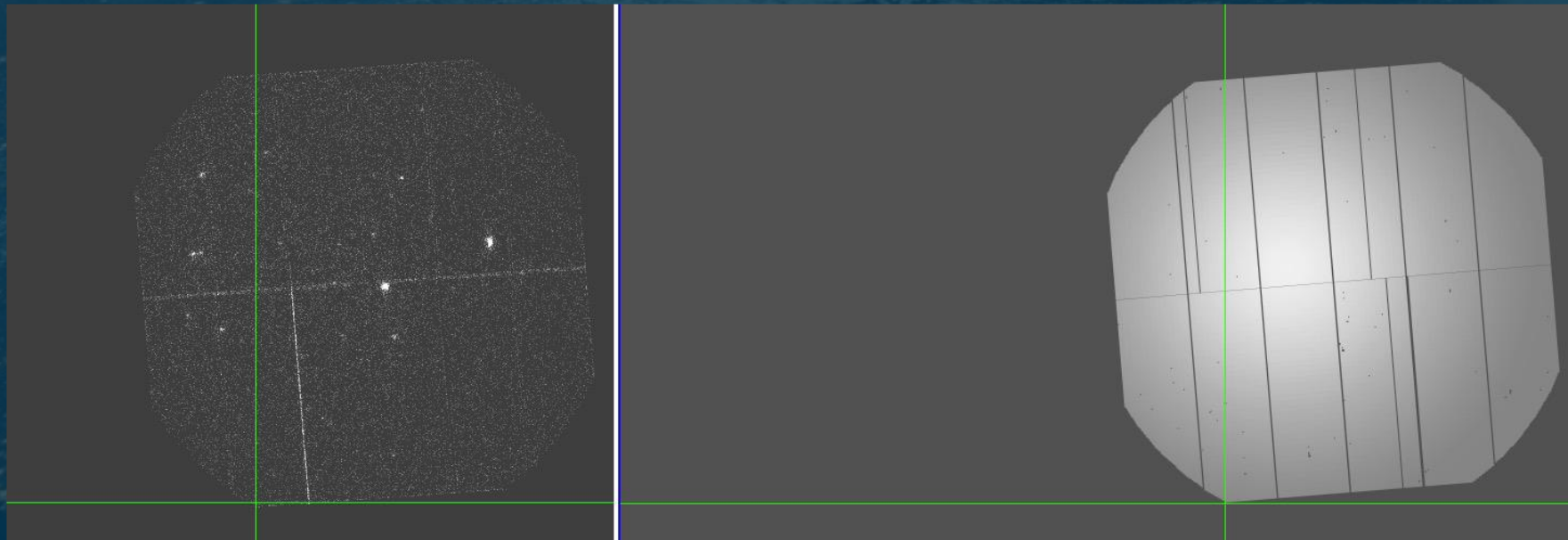10 x 10 deg FOV mosaic   Position offset at edge of mosaic with SAS 21

Image

Exposure Map

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SAS v22 astrometry fix for large mosaic images
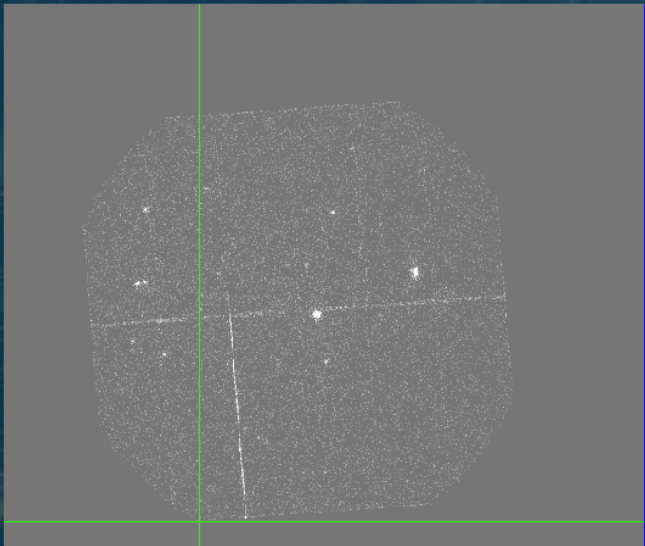
Modified attcalc and eexpmap using Helpdesk question observation as test case (SAS 22)

10 x 10 deg FOV mosaic

Image

Exposure Map

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UG recommendations I

Recommendation 2021-06-10/15: The UG considers it to be important that the SAS source code is made public (and that any remaining copyright issues are resolved) and that the distribution and installation of SAS is made easier and in modern ways. Therefore, the UG strongly recommends to complete these processes as soon as possible.

- Still working on removing proprietary code from SAS (mainly Numerical Recipes)
- Refinement of the validity checks from the ESA PA group using a tool called *fossid*
- Additional manual deep dive to the source code, found all likely NR affected cases involving 24 packages.
- The most affected packages, *emldetect* and *omgrism* have been reworked and pass the screening
- Still sixteen packages being worked on
- Scientific validation of the changed code is the most critical and time-consuming part

UG recommendations II

Recommendation 2021-06-10/16: The UG recommends to complete the transformation of the code to Python and eliminate all problematic dependencies (i.e., PGPLOT/Grace, Perl, HEASARC dependencies).

Status: Ongoing (work is on-going, happy to acknowledge the help of GOF with the Python SAS infrastructure code).

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UG recommendations III

Recommendation 2023-05-11/09: The UG recommends to keep documenting precisely the changes between SAS versions (and ESAS tool), with a change log keeping all changes from version to version, including default filtering values. It recommends trying to maintain new versions of ESAS tool backward-compatible, using the standard ESAS names by default. This is particularly important for the analysis of extended sources in long-term programs such as multi-year heritage programs. (Also see presentation from Gabriel Pratt - https://www.cosmos.esa.int/documents/332006/12510501/Source_Analysis.pdf)

New SAS continuous integration and development environment will help (see later).

ESAS & CHEX-MATE

1. SAS 20 gave 14% more counts in EPIC-pn, 10-14 keV band than SAS 16 due to change of event filtering criteria in the pn-filter task. Flag change from 0x766a0f63 to #XMMEA_EP.

Response: Will be changed back to (FLAG& 0x766a0f63)=0 in SAS 22 (NB: pn-filter was a wrapper for espfilt, which should now be called directly – see the esas cookbook https://heasarc.gsfc.nasa.gov/FTP/xmm/software/xmm-esas/xmm-esas.pdf)

2. Anomalous MOS CDDs excluded in SAS 20 whereas they were included in SAS 16 due to change in thresholding level.

Response: the SAS 20 thresholding level is preferred and will be maintained in SAS 22

ESAS & CHEX-MATE

3. BACKSCAL value quantisation for small extraction regions and possibly wrong values in SAS 20 mos-spectra and pn-spectra

This is caused by the setting of the badpixelresolution parameter in mosspectra and pnspectra, hard-coded in SAS 20 to search for bad pixels/columns using a 16"x16" grid, which is optimised for large source extraction regions to keep the execution time reasonable. In SAS 16 a grid size of 2"x2" was used. In SAS 21 and 22, the value defaults to 16"x16" but may be set by the user on the command line. For smaller source regions it is recommended to use a finer resolution.

4. Changes in names of *esas* tasks and names of parameters from version to version

Esas tasks in SAS 21 have new names and many new parameters. From now on we will keep versions consistent.

Recommend:

- *Provide a rapid patch to SASv20 to apply the same FLAG selection as in previous versions* ❌
- *Provide full documentation to ESAS tool and change log with ALL changes from version to version* ✅
- *Try to keep any new version of ESAS tools backward-compatible* ✅
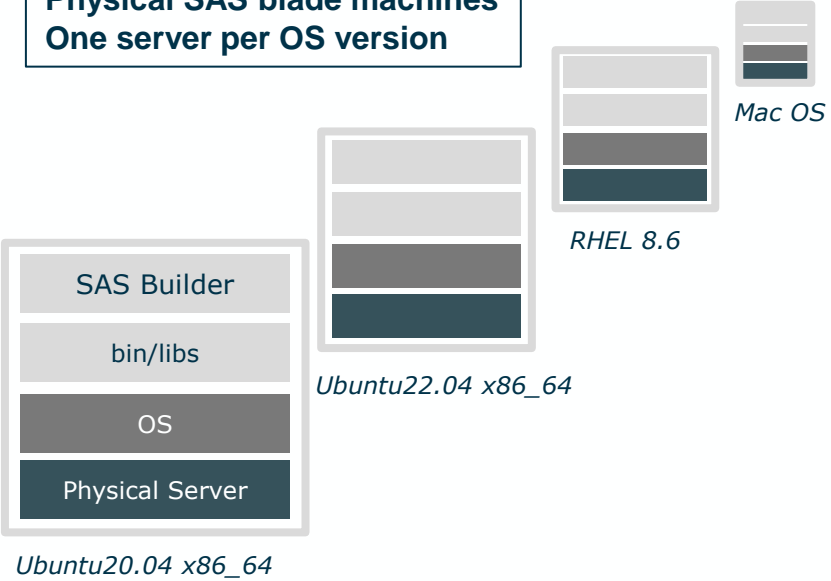
UG recommendations IV

Recommendation 2023-05-11/10: The UG recommends that adequate user support be made available to facilitate and optimize the use of new SAS developments, particularly for python, with dedicated documents or tutorials.

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Active Developments

1. Configuration Control and overnight build system renovation, including integrated development environment for internal and external developers.

2. Use of SAS within on-line processing environments

    a. Implement SAS processing threads as Jupyter notebooks within the Datalabs (ESA) or SciServer (NASA) infrastructure

    b. Recent progress made on

- Interactivity within the Jupyter Lab
- Image visualization: jpyjs9
- Light-curve visualization: lcviz
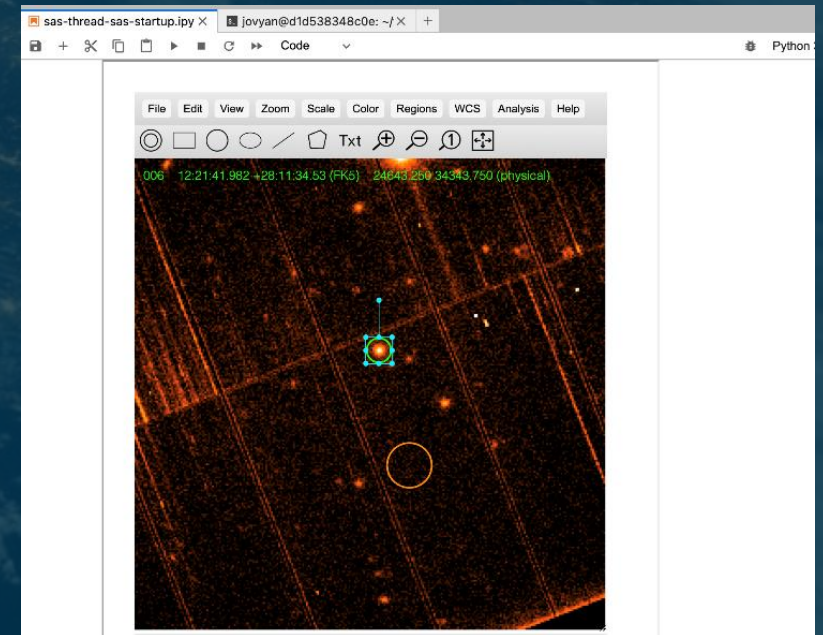
Current SAS Building and Development Infrastructure

Physical SAS blade machines
One server per OS version

Mac OS

RHEL 8.6

| SAS Builder |
| bin/libs |
| OS |
| Physical Server |

Ubuntu22.04 x86_64

Ubuntu20.04 x86_64

SAS building infrastructure manually built for each OS
Infrastructure requires starting from scratch with new OS
High alignment with IT team
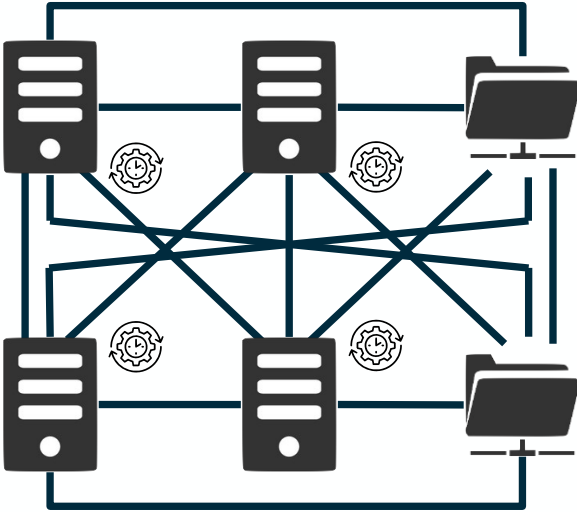
SAS SW Development requires setting-up a complex development environment or access to the development env provided by SOC
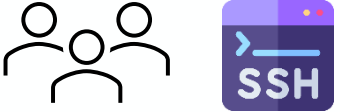
SAS SW contributions based on ad-hoc system
SAS daily builds based on tar.gz package repository and orchestrated with custom made tools

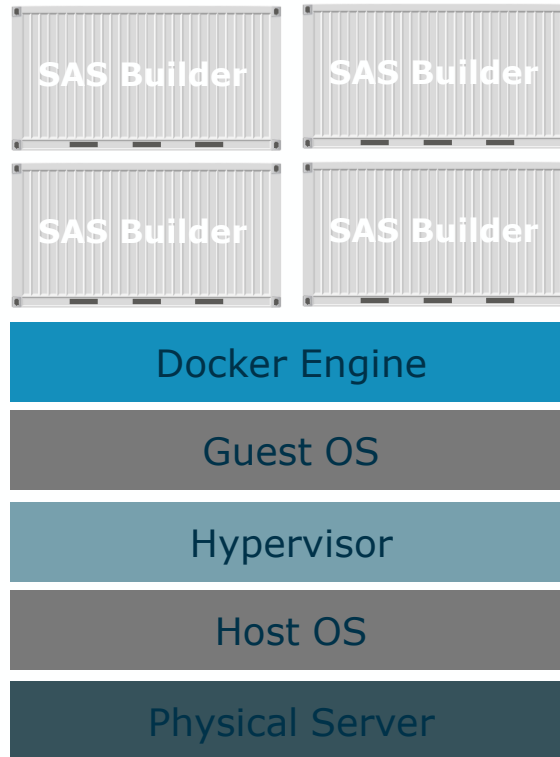# New CI/CD SAS Building and Development Infrastructure

Docker technology to automatically build SAS building infrastructure in different OS

- Reduce maintenance effort
- Increase reliability
- Streamline scientific validation
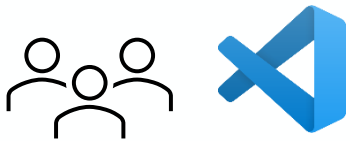
SAS Virtual Development Environment

Jenkins and Kubernetes technology to orchestrate automatic deployment and testing

SAS Builder   SAS Builder
SAS Builder   SAS Builder

Docker Engine

Guest OS

Hypervisor

Host OS

Physical Server

Functional tests

SAS build
Unit tests

E2E Scientific validation and regression testing

SAS source code management system

ATLASSIAN
Bitbucket

SAS code moved from GIT to Bitbucket

SAS evolution : DL4SAS + Threads

- To help users to analyse XMM-Newton data, a set of Data Analysis Threads are being provided to the community.

- SAS as a docker can be used in any cloud platform.

- Scientific cloud platforms (Datalabs and SciServer) uses Jupyter Lab as user interface

- Aids collaborative work between astronomers (ADASS tutorial proposed)

- SAS is being adapted to these platforms to provide to the user the basic functionalities to work with XMM-Newton data:

Upload Jupyter NB Thread
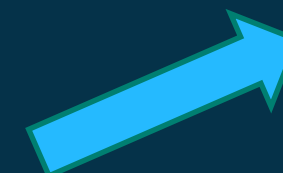
New user: *register in DataLabs (access is currently moderated)*

Select DataLab

Summary

- **SAS 22 planned release October 2024**

- **New configuration control, build and development system close to being released**

- **Integration with on-line data processing platforms being pursued**

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